Our companies and products

Hanson UK is the leading supplier of heavy building materials to the UK construction industry. We are split into three business lines – Hanson Cement, Hanson Building Products and Hanson Quarry Products. Hanson UK is owned by the HeidelbergCement Group, which employs over 53,000 people and operates worldwide. Hanson UK employs around 5,300 people across over 300 sites.

For detailed information on all areas of Hanson and our products visit: **www.hanson.com/uk**

Hanson HEIDELBERGCEMENT Group

Hanson Quarry Products

- Crushed rock
- Sand and gravel
- Asphalt
- Contracting
- Ready-mixed concrete
- Ready-mixed mortar
- Screed
- Civil engineering

Hanson Cement

- Bulk cement
- Regen Ground Granulated Blast furnace Slag (GGBS)
- Fly Ash
- Packed products

Hanson Building Products

- Bricks
- Blocks
- Precast concrete products
- Permeable paving (SUDS)
- Chimneys and roofing
- Cladding
- Off-site solutions
- Specialist brick and block laying

SMARTPHONE SCAN CODE

For more information, or to book a free on-site CPD presentation on **Specifying Sustainable Concrete** please go to **hanson.com/uk/regen** or call **0800 130 3003**

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REGEN®

The strength behind sustainable concrete

What is **Regen?**

Regen Ground Granulated Blast furnace Slag (GGBS) is a cement substitute, manufactured from a by-product of the iron-making industry. The use of Regen in concrete reduces embodied CO_2 emissions by over 900kg per tonne of cement, and also increases its durability. Regen is more sustainable than other cement substitutes such as Fly Ash.

In the UK, GGBS is usually supplied as a separate component for concrete and is added at the concrete mixer. It can replace up to 70 per cent or more of the Portland cement. In British Standards GGBS is referred to as an 'addition' and counts fully towards the cement content in concrete. Regen is available throughout the UK, accompanied by a full technical and logistical support package.

Production of iron blast furnace slag

The cementitious properties of blast furnace slag were discovered in the late 19th century and it has been widely used in cement and concrete manufacture for over 100 years.

Blast furnaces operate at temperatures up to 2000°C and are fed with a carefully controlled mixture of iron ore, coke and limestone. The iron ore converts to iron, which sinks to the bottom of the furnace. The remaining materials form a slag that floats on top of the iron. The molten iron and slag are drawn off at regular intervals from the furnace. As the slag is drawn off, its chemistry is monitored as a check on the performance of the furnace. This ensures that the slag is very consistent in chemical composition. After being tapped from the furnace and separated from the iron, the slag is rapidly quenched in water. This process is known as granulation because it produces glassy granules, similar in appearance to a coarse sand. These have excellent cementitious properties.

The company

Regen is manufactured by Hanson Cement which acquired Civil & Marine in 2006. Regen from Hanson Cement is the only GGBS manufactured in the UK.

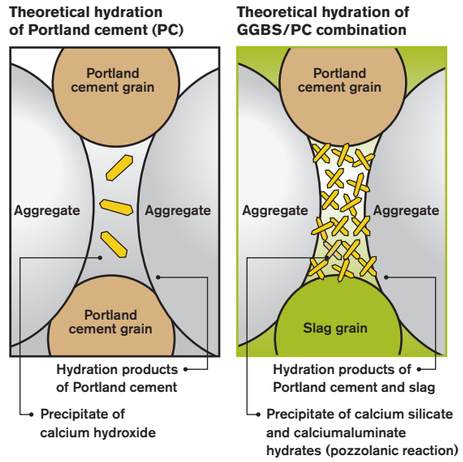
Hanson Cement operates under strict quality and management procedures and is proud of its ISO9001, ISO14001, BS OHSAS 18001 accreditations. It is the only UK cement producer to have an Integrated Management System certified to PAS 99. The company also places great emphasis on minimising its environmental impact, and manufactures its products in as sustainable a manner as possible.

The hydration process

GGBS can be used as a replacement for cement because the hydration process is very similar to that of Portland cement. When Portland cement reacts with water, the insoluble hydration products form close to the cement particle. The more soluble product of hydration (calcium hydroxide) precipitates as discrete crystals, surrounded by large pores. When GGBS particles are also present, both the GGBS and Portland cement hydrate.

Additionally, the GGBS reacts with the excess of calcium hydroxide to form a finely dispersed hard gel, which fills the larger pores. The result is a hardened cement paste, which contains far fewer calcium hydroxide crystals and therefore has fewer large capillary pores. The reduction in free calcium hydroxide makes concrete chemically more stable, and the finer pore structure limits the ability of aggressive chemicals to diffuse through the concrete.

Another cement addition is Fly Ash from power stations. The hydration process for Fly Ash is pozzolanic, rather than cementitious.



Principal Oxides

	CaO	SiO_2	Al_2O_3	MgO	Fe_2O_3
Regen	40%	35%	12%	10%	0.2%
Portland cement	65%	20%	5%	1%	2%

Benefits

Wales Millennium Centre, Cardiff

Sustainable

- **Low embodied CO_2**
- Produces low CO_2 concrete
- No mineral extraction
- Reduced landfill
- Meets your criteria for sustainable construction

Durable

- **Produces more durable concrete**
- Concrete made with Regen will last longer in aggressive environments

Attractive

- **Lighter coloured concrete – near-white**
- Aesthetically pleasing
- Safer in dark areas

Availability

- Available nationwide

Support

- Full package of technical support available

Cost-effective

- Using Regen is a cost-effective method of making more sustainable and durable concrete

Persistence Works, Sheffield

Spinnaker Tower, Portsmouth

Sustainability

Regen is a highly sustainable cement substitute. From its low-emissions production process to its use in long-life structures, concrete made using Regen provides many sustainability benefits.

With a worldwide production of 1.4 billion tonnes a year, the manufacture of CEM I Portland cement is regarded as a high-emissions industry. The use of cement replacements provides opportunities for significant reductions in energy use and carbon dioxide emissions.

The most effective alternative to Portland cement is Hanson Regen, which typically replaces 50 per cent of the Portland cement in a concrete mix. Greater proportions of up to 80 per cent can be used, with advantages in suitable situations.

There are environmental benefits to be gained from the use of Regen as a cement substitute in both the production process and throughout the life of the structure. In its production process, Regen:

- Generates very low CO_2 emissions, as it is a by-product of iron-making
- Produces very low emissions of the harmful gasses SO_2 and NO_x
- Requires virtually no quarrying or mineral extraction

The increased durability of concrete manufactured using Regen further reduces a project's environmental impact by:

- Reducing the amount of repair and maintenance required
- Extending the service-life of concrete structures

A comparison of the environmental impacts of Regen and Portland cement is given in the table below.

Comparison of environmental benefits of Regen and Portland cement (PC)

Environmental issue	Measured as	Impact	
		One tonne of GGBS[1]	One tonne of PC
Climate change	CO_2 equivalent	0.07 tonnes	0.95 tonnes
Energy use	Primary energy[2]	1,300 MJ	5,000 MJ
Mineral extraction	Weight quarried	0	1.5 tonnes
Waste disposal	Weight to tip	1 tonne saved[3]	0.02 tonnes

Notes:

1. No account has been taken of the impacts of iron-making because the slag is created regardless of whether or not it can be used.
2. Includes energy involved in the generation and distribution of electricity.
3. The use of slag for the manufacture of GGBS saves it from potential disposal.

Source: Higgins D D, Sustainable concrete: How can additions contribute? Institute of Concrete Technology Annual Technical Symposium, 2006

Producing 100m³ of concrete uses 32 tonnes of cement

Replacing 50% of the cement with Regen saves 12.96 tonnes of CO_2

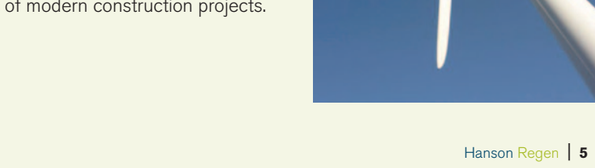
42 — Equal to taking 42 cars off the road for one year

41 YEARS — Equal to 41 years of electricity usage in the average home

Comparison of emissions CO_2 kg/t

	Portland cement	Regen
Process emissions	640	0
Fossil fuel use	100	30
Generation of electricity used	230	25
Total	970	55

Typical CO_2 emissions for Portland cement vs Regen



Case Study:

Clyde Wind Farm

Due to its strong environmental credentials, Regen was used in the construction of the Clyde Wind Farm in Scotland.

This development of 165 wind turbines creates around 580MW of electricity for 370,000 homes. The base of each turbine contains 350m³ of concrete, with a cementitious content of 400kg per cubic metre. A replacement content of 70 per cent was specified to ensure that the structure met its environmental and durability criteria, using a total of over 16,000 tonnes of Regen.

The Clyde Wind Farm, built on behalf of Scottish and Southern Energy Renewables, provides a powerful example of how Regen can be used to increase the sustainable credentials of modern construction projects.

Durability

Using Regen as a cement substitute in concrete increases its durability and resistance to deleterious reactions.

Sea Defences, Blackpool

Resistance to deleterious reactions

Sulfates occur naturally in the ground and can sometimes have a harmful effect on concrete, causing it to crack and disintegrate. The main reactions are known as ettringite and thaumasite. The use of Regen in concrete greatly increases resistance to sulfate attack. This is well recognised by codes and standards. In the latest version of the British Standard for concrete (BS8500), the only option recommended for the most severe sulfate exposure is a concrete with a cement replacement of at least 66 per cent GGBS.

Ettringite – The primary sulfate reaction that causes disruption of hardened concrete is associated with one of the minor compounds in Portland cement, tricalcium aluminate. This can combine with sulfate ions that have penetrated the concrete and form a new hydrate (ettringite), which occupies a volume greater than the original constituents. This generates high internal stresses in the concrete that can cause it to crack and disintegrate.

Thaumasite – Another form of sulfate attack, called thaumasite attack, has been recognised as a problem after the discovery of its effects on some M5 motorway bridges. Thaumasite is a hydrate, which forms at temperatures below 15°C through a reaction between cement paste hydrates, carbonate and sulfate ions. Its formation reduces the cement paste to a soft mulch, undermining the concrete's durability and stability.

Alkali-silica reaction (ASR) – A reaction between the hydroxyl ions in the pore water within a concrete, and certain forms of silica which are present in some aggregates. This produces a gel which imbibes pore fluid and expands; in some instances this expansion induces internal stress of such magnitude, that it causes extensive micro-cracking of the concrete. The damage occurs in parts of the concrete structure exposed to moisture, meaning Regen can reduce the risk of damage. Due to its reduced permeability and increased chemical stability, concrete containing Regen is resistant to ASR.

Chloride attack

Chlorides attack concrete by breaking down the passive layer that protects steel reinforcement. This layer is formed on the surface of the steel as a result of the high alkaline environment produced by hydrating cement. Certain types of concrete are more vulnerable to attack because it is easier for the chloride ions to reach the steel reinforcement.

When CEM I Portland cement hydrates, the resultant pores are relatively large and can easily allow chloride ions to penetrate into the heart of the concrete to attack the embedded metal. The result is rapid corrosion of the steel reinforcement which can take the form of localised pitting or general corrosion.

To prevent the penetration of chloride ions, a dense concrete of very low permeability needs to be produced and this can be achieved by incorporating GGBS.

Where structures are subject to attack from chlorides from an external source, a minimum of 50 per cent GGBS should be used, with a higher proportion used in areas where high levels of chlorides will be encountered.

Heat of hydration

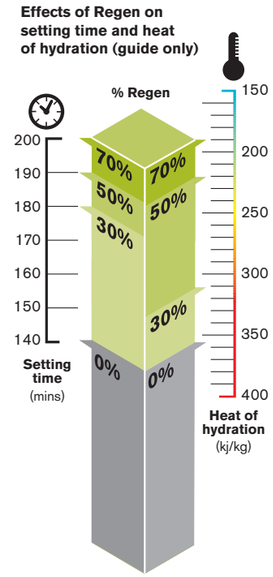
The hydration of cement is an exothermic reaction. The use of Regen reduces the heat of hydration. High temperatures in concrete can generate stresses that could result in early-age thermal cracking. This cracking is known to have caused issues with some structures, so the use of Regen is recognised as an effective solution to the problem. Heat of hydration is of critical importance on large pours of concrete, to reduce thermal cracking. Regen was used successfully in the construction of The Shard in London, the UK's largest ever concrete pour.

The percentage of Regen used directly affects the heat of hydration; a replacement level of around 70 per cent is recommended for large pours. A temperature reduction of up to 40 per cent can be achieved with a 70 per cent replacement level.

Setting times

Concrete produced with a proportion of Regen has a slightly longer setting time than cement-only concrete. In practice, these extended setting times give greater opportunity for working the concrete, and provide more flexibility on site to compensate for any delivery delays or adverse working conditions.

Concrete with a cement content containing 50 per cent Regen will have a setting time of approximately half an hour longer than cement-only concrete, although this can be affected by the water/cement ratio and ambient temperature. We recommend carrying out tests to ensure the correct mix ratios.



Case Study:

Sea Defences

The light colour and impressive durability of Hanson Regen led to its use in the Blackpool Sea Defence project.

Five headlands were created over a 3.3km stretch of seafront in the Lancashire resort, using around 5,200 tonnes of Regen in 23,000m^3 of concrete.

The challenge was to ensure that the precast concrete sections were strong enough to protect and survive in a harsh environment, whilst remaining attractive in the popular holiday destination. Hanson Cement's expertise was crucial in fulfilling the tough requirements for this project, with Regen providing a strong, durable and attractive solution.

Appearance

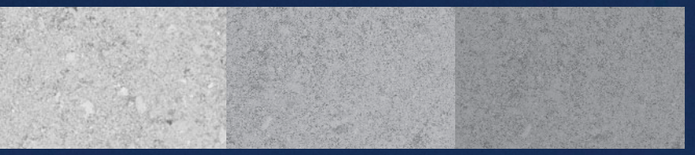
Regen provides a superior, lighter coloured finish than concrete made using Portland cement-only mixes.

In particular, Regen enables:

- A lighter coloured concrete
- Greater reflectivity, providing better visibility and therefore safety in dark environments
- Reduced efflorescence

Because of the near-white colour, Regen can be used as a replacement for White cement, with only a minimal difference in whiteness. However, for architectural applications where brightness is a critical factor, it is still recommended to use White cement wherever practical.

Colour difference comparison when using 50% Regen in concrete.



50% Regen **100% Portland cement** **30% Fly Ash**

Spinnaker Tower, Portsmouth

Applications

Regen has been specified and used in many major projects, and has a wide range of applications.

Regen is ideal for use in projects where sustainability and durability are essential requirements. Example applications include:

Soil stabilisation

Stabilisation of soil with cementitious binders is widely used in road, pavement and foundation construction, to improve the engineering properties of the soil. It can increase the strength and bearing capacity, improve stability by controlling the swell-shrink caused by moisture changes, and can increase the resistance to erosion, weathering and traffic loading.

Stabilisation of the existing soil is usually a much more sustainable solution than importing aggregate.

Use of a lime and Regen combination offers significant advantages for soil stabilisation. The major advantage is that it can inhibit the deleterious swelling that sometimes occurs with clays containing sulfates.

Mortar

Regen can be used to replace a proportion of the cement when preparing mortars. This can be a cost-effective way to reduce the environmental burden of the structure and increase its durability. The lighter colour reduces the need for pigmentation.

Precast concrete

The increased sustainability and durability of concrete made with Regen has made it popular for use in precast concrete structures.

Paving and street furniture

Paving, street furniture and other structures made with Regen have an increased service life, reduced manufacturing costs and benefit from lightened colouring.

Specialist projects

Hanson has considerable experience in advising on the best way to use Regen on projects with very specialised requirements. For example, Regen has been used for the encapsulation of radioactive material, where its lower heat of hydration and enhanced durability have been key factors. These properties have also led to Regen being used in slurry walling projects, sea defences and other structures in aggressive conditions.

Second Severn Crossing

Regen was used in the construction of the Second Severn Crossing road bridge (pictured above) to ensure durability and attractive appearance.

Liquid natural gas tanks, Milford Haven

Logistics and support

CPD presentations

Hanson Cement is able to provide your practice with a full Continual Professional Development (CPD) presentation on the specification and use of Regen, as well as other cement substitutes in sustainable construction. To request more information or to book a CPD presentation, please contact the CPD booking hotline on **0845 130 3003**

Each presentation lasts approximately one hour, is RIBA accredited and counts towards your CPD points for the year. A Certificate of Attendance will be issued after the event.

NBS Plus

Regen is also listed on the NBS Plus system, where you can easily download the technical product information into your project specification.

Ordering

Regen can be ordered by calling the Hanson Cement Order Hotline on **0808 100 3333** Our experienced team will be able to provide all the information you require for taking delivery of Regen. Alternatively, please specify Regen to your preferred concrete manufacturer.

Mix designs

Regen delivers its best performance when used in the correct proportions for the job. To help you design and specify the best mix, we have a team of Technical Development Managers who have experience in working on major projects. Please contact our Customer Services team on **0845 600 1616**

Concrete production

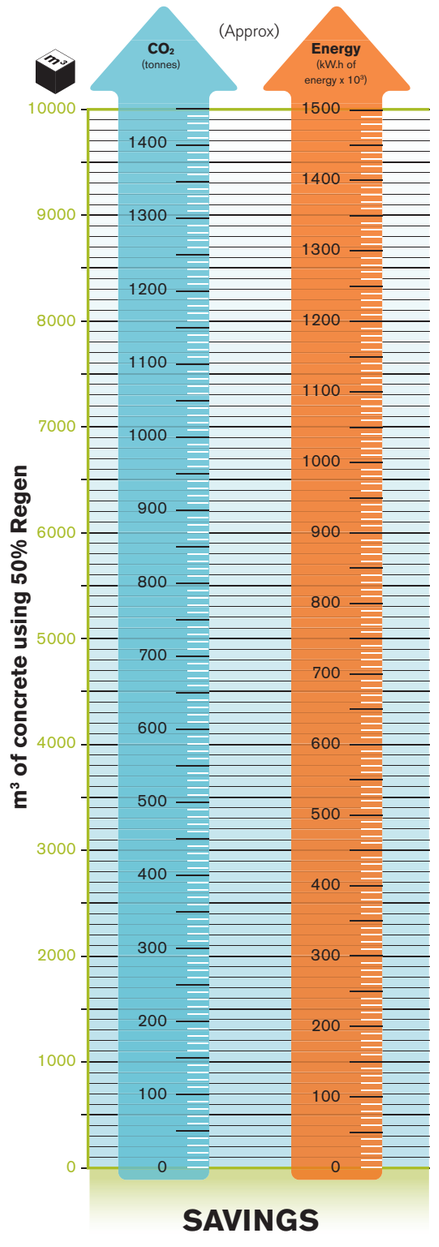
Once you have specified Hanson Regen, the mix itself will generally be prepared and delivered by your concrete producer. We have great experience in working closely with concrete producers, and have a fleet of vehicles dedicated to delivering Regen to them.

Our fleet reflects our environmental credentials; we ensure that our journey plans are as efficient as possible and we are proud of our policy of "never running empty."

Carbon calculator

Using Regen delivers considerable environmental benefits, including reductions in embodied CO_2

m³ of concrete using 50% Regen
(assumes typical cement content of 320kg per m³)



Tonnes of Regen used